Hollow profile with a polyurethane foam filling and process for the production of a hollow profile filled with a polyurethane foam

This invention relates to a hollow profile with a polyurethane foam filling and to a process for the production of a hollow profile filled with a polyurethane foam.

Hollow profiles, for example window profiles, are provided with a foam filling for thermal insulation purposes or plain tubes, for example for ski sticks, are filled with foam for reinforcement purposes. Twin-walled tubes with foam thermal insulation arranged between the walls are also already known. In this case, the reaction mixture is introduced either by means of a mixing head drawn through the gap between the tubes or the mixture is applied onto a strip of paper outside the tube and said strip is continuously drawn into the cavity which is to be filled with foam (Kunststoff Handbuch, volume 7, "Polyurethane", 3rd edition, Carl Hanser Verlag, Munich-Vienna, page 283; ISBN 3-446-16263-1). It is moreover generally known to introduce reinforcing nonwovens into hollow articles before filling them with foam, said nonwovens being permeated by the reaction mixture, such that a higher density and thus stronger foam is obtained in this area.

In the case of narrow hollow profiles, it has proved difficult to introduce a liquid reaction mixture to fill the cavity with foam. In particular, if plastics profiles, for example made from PVC, are used, there is a risk that the profile will be deformed in an unwanted manner by the pressure of the foam.

The object thus arises of providing a hollow profile, the foam filling of which exhibits a uniform density and a low foam pressure over the length of the profile and moreover possesses good adhesion to the internal wall of the hollow profile.

This object is achieved by a support material insert permeated by the polyurethane foam, which insert, in the prior foam-free initial state, in the period of time from application of the liquid reaction mixture onto this support material insert until the introduction of this support material insert together with the reaction mixture into

the hollow profile, exhibits impermeability to this reaction mixture and which, after introduction into the hollow profile prior to the incipient increase in viscosity of the rising foam, is permeable to this reaction mixture.

In this manner, it is ensured that the support material insert acting as support strip which may be drawn into the cavity together with the reaction mixture prevents, by virtue of its permeability delayed by the stated period of time, the support material insert from being permeated by the reaction mixture before the introduction thereof into the hollow profile. It is thus also impossible for the reaction mixture to be scraped off in contaminating manner at the profile inlet. On the other hand, the existing permeability which is, however, delayed for the stated period of time, ensures that, once introduced into the cavity, this reaction mixture is capable of permeating the support material insert during, or even before, foaming and thus, on curing, also achieves good adhesion with the internal wall of the cavity on the far side of the insert. It is immaterial here whether the support material insert floats somewhat or becomes a little distorted because all that is important in foam filling is proper introduction of the reaction mixture and, optionally, thermal insulation, as the support insert has no reinforcing function.

It is indeed known from the cited "Kunststoff Handbuch", volume 7, page 283 that when foam filling tubes, "the paper strip must be drawn in completely when the foaming reaction starts". However, this provides no information as to the permeability of the paper strip and, specifically neither as to the onset of permeability to the liquid reaction mixtures nor whether the paper strip is ever permeable to the foaming reaction mixture. In contrast to known insert strips, the novel support material insert performs a completely different task. It is also not necessary for the support material insert to be completely drawn into the hollow profile before it becomes permeable. Instead, it is merely necessary for the particular portion of the support material insert bearing the reaction mixture always to be drawn into the hollow profile before it becomes permeable.

The support material insert preferably consists of a fibrous nonwoven, a woven textile fabric, such as linen or cotton, or a paper with appropriately delayed permeability.

Due to the numerous influencing factors, suitable support material inserts are best identified empirically. If it is assumed on the basis of experience that the reaction mixture exhibits a viscosity of 100 to 800 mPa s before or until it is inserted into the cavity, support materials which have proved particularly suitable are those consisting of polyester nonwovens with a basis weight of between 30 and 60 g/m² and thicknesses of 0.4 to 0.6 mm. Fibre thickness naturally also has an influence here. Tightly woven fabrics, such as for example bleached and washed cotton fabrics, with basis weights of 200 to 300 g/m² are also suitable. Tests have revealed that, under the stated conditions, such support materials are capable of retaining a liquid reaction mixture for approx. 5 to 20 seconds before the mixture starts dripping through. Provided that the correct drawing in speed and correct distance between the mixture application point and the profile inlet are selected, no problems arise.

Another particular embodiment is characterised in that the lateral edges of the support material insert are turned up in the manner of a trough.

In the case of tubular hollow profiles having a curved internal cross-section, the support material insert has an appropriate curvature even before it is introduced into the cavity. In the case of a rectangular internal cross-section, the lateral edges are folded up, especially if the profile is narrow. This prevents the reaction mixture from running off over the edges of the support insert before introduction into the cavity. The lateral edges should not be too tall as there is otherwise a risk that, due to its increasing viscosity, the rising foam will no longer be able to permeate the upper part of the lateral edges, consequently meaning that there would be no adhesion between the foam filling and the internal wall of the profile at this point. In the case of profiles with a wide internal cross-section, this risk does not generally arise because the reaction mixture is applied along the middle and cannot flow out laterally as far before introduction. In this case it is unnecessary to turn up the lateral

edges. In the case of narrow rectangular hollow profiles, it is also possible to arrange them for foam filling with their wide, flat internal wall at the bottom so as to avoid turning up the lateral edges. The hollow profile may then optionally have to be rotated by 90° for its final use. It is immaterial that in such cases the support material insert is ultimately disposed vertically.

Once aware of the novel support material insert, the person skilled in the art of polyurethane will have no difficulty in making a selection from the wide range of reaction mixtures suitable for producing the insulating foam filling.

It has, however, proved particularly advantageous for the starting components of the reaction mixture used to produce the foam filling to comprise elevated proportions of long-chain polyols and/or di- and/or isocyanate polymers.

Provided that the correct metering rate is selected for the reaction mixture, selecting such reaction components also advantageously promotes a low foam pressure and foam stability with regard to heat treatment when the profiles are painted. Such painting is generally necessary for aluminium profiles; painting is not necessary for plastics profiles, for example made from PVC, as the plastic may generally itself be coloured the desired colour.

The process for the production of the novel hollow profile takes as its basis a hollow profile filled with polyurethane foam, wherein a liquid reaction mixture is applied onto a support material insert, while the support material insert together with the reaction mixture is simultaneously drawn into the hollow profile at a constant speed.

The novelty of the process is that a support material insert is used which exhibits delayed permeability to the reaction mixture, wherein this period of delay extends from the time of application of the reaction mixture until introduction into the hollow profile, and that thereafter the support material insert becomes permeable to the reaction mixture and, as it forms, the foam adheres to the internal wall of the profile over the entire cross-section of the profile.

The support material is drawn in, for example, using a rod which may be moved to and fro by means of a driven pinion on a rack downstream from the rod. A coilable link chain which exhibits sufficient rigidity at its hinge points, for example by virtue of protruding tabs, when it slides over the bottom internal wall of the profile is also conceivable.

The support material insert drawn in preferably comprises a fibrous nonwoven, a woven textile fabric, such as linen or cotton fabric, or paper.

Particularly advantageously, the lateral edges of the support material insert are turned upwards before application of the reaction mixture.

The starting components of the reaction mixture used to produce the foam filling preferably comprise those having elevated proportions of long-chain polyols and/or di- and/or isocyanate polymers.

The advantages of the process variants have already been described in relation to the structure of the novel hollow profile.

The drawings show a purely schematic diagram of the novel hollow profile and the production thereof in one exemplary embodiment, described in more detail below. In the drawings:

Fig. 1 is a longitudinal section of the hollow profile,
Fig. 2 is a cross-section of the hollow profile and
Fig. 3 is a partially sectional side view of an apparatus for the production of this hollow profile.

In Figs. 1, 2, a substantially rectangular hollow profile 1 consists of a window profile of plastics, specifically made from coloured PVC. For clarity's sake, the hollow profile 1 is shown merely as a simple rectangular profile. A thermally

insulating foam filling 2 of polyurethane foam is arranged within the hollow profile. In the lower part of the filling there is a support material insert 3 of a polyester nonwoven which, in its original state, exhibits a basis weight of 40 g/m² and a thickness of 0.5 mm. In accordance with the bottom, flat inner wall 4 and the perpendicular inner side walls 5 of the hollow profile 1, the lateral edges 6 of the support material insert 3 are folded up perpendicularly by approx. 8 mm. The support material insert 3 together with its lateral edges 6 is completely permeated by the foam, such that the foam filling 2 everywhere exhibits good adhesion to the inner wall 4 of the hollow profile 1. The polyurethane reaction mixture used comprised long-chain polyols and/or di- and/or isocyanate polymers.

According to Fig. 3, a rack 7 interacts with a pinion 9 driven by a motor 8. A rigid drawing rod 11 is arranged on the axis 10 of the pinion 9, which rod extends through a hollow profile 1 to be filled with foam, which may be moved away laterally, and the other end of which rod has a clip 12 to grip a support material insert 3 drawn off from a supply reel 13. The lateral edges 6 of the support material insert 3 are turned upwards by means of a folding apparatus 14, specifically before the reaction mixture 15 is applied onto this support material insert 3 by means of a mixing head 16. The driven pinion 9 travels at a constant speed along the rack 7, the speed being adjusted such that the applied reaction mixture 15 only permeates the support material insert 3 once it has been introduced into the hollow profile 1. On the other hand, permeation still proceeds promptly enough for the reaction mixture 15 still to have a viscosity which is sufficiently low for this purpose. Once the support material insert 3 together with the reaction mixture 15 has been introduced into a length of the hollow profile 1, the clip 12 is released and a cutting apparatus 17 arranged at the inlet side of the hollow profile 1 cuts off the support material insert 3. The hollow profile is now moved away laterally by means of a trolley 18 arranged thereunder and sealed at both side with flaps 19. The reaction mixture 15 now foams and cures to yield the foam filling 2, which everywhere exhibits good adhesion to the inner wall 4 of the hollow profile 1. On foaming, the support material insert 3 changes its position, but this is immaterial. Once the foam filling 2 has cured, the flaps 19 are opened and the hollow profile 1 filled with foam is complete and is removed.

Another hollow profile 1 is placed upon the trolley 18, which, together with the hollow profile 1, is returned to the filling position etc..